

EXHIBIT A

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

SYNOPSISYS, INC., a Delaware)	
corporation,)	
)	
Plaintiff,)	
)	
v.)	C.A. No. 05-701 (GMS)
)	
MAGMA DESIGN AUTOMATION,)	
INC., a Delaware corporation,)	
)	
Defendant.)	
_____)	

**REPLY DECLARATION OF DAVID HARRIS, PH.D. IN SUPPORT OF
SYNOPSISYS, INC.'S ANSWERING CLAIM CONSTRUCTION BRIEF**

I, DAVID HARRIS, declare:

1. I have been retained as an expert consultant by the law firm of Dechert LLP (“Dechert”), counsel of record for plaintiff Synopsys, Inc. (“Synopsys”) in the above-captioned matter. The following declaration is based on my personal knowledge. If called upon to testify, I could testify competently as to the matters set forth herein.

2. A description of my qualifications is set forth in my Declaration In Support of Synopsys, Inc.’s Opening Claim Construction Brief (hereinafter referred to as my “Original Declaration”) at ¶¶ 2 through 8. D.I. 141, Exhibit A, ¶¶ 2-8.

I. MATERIALS CONSIDERED.

3. This declaration is submitted in support of Synopsys’ Opposing Claim Construction Brief regarding construction of the claims of U.S. Patent No. 6,192,508 (“the ‘508 patent”) and U.S. Patent No. 6,519,745 (“the ‘745 patent”). Copies of the ‘508 and ‘745 patents are found in the Joint Appendix of Intrinsic and Extrinsic Evidence (the “JA”) at (1 A-1 - A-9) and (8 A-56 - A-69), respectively.¹

4. In preparing this declaration, I have reviewed Magma Design Automation’s Opening Markman Brief (“Magma’s Markman Brief”). D.I. 142. I have also reviewed Magma Design Automation’s Amended Opening Markman Brief (“Magma’s Amended Markman Brief”). D.I. 145. In addition, I have reviewed the declaration of my colleague, Dr. Edmond S. Cooley (“Cooley Declaration”), which was submitted in support of Magma’s Markman Brief. D.I. 143.

¹ Pursuant to D. Del. LR 7.1.3(a)(C), all citations are to the Joint Appendix of Intrinsic and Extrinsic Evidence (the “JA”). Citations are in the following format: “[Tab#] A-[page#].” Thus, a citation to “3 A-100” would refer to tab 3, page A-100. Patent citations are by column and line number, in the following format: “[Tab#] A-[page#] at [column]:[line].”

5. In preparing this declaration, I have also considered the following publications:

- Kyung et al., "An Evolutionary Strategy For The Global Placement Of Macro Cells," *IEEE Symp. Circuits and Systems*, © 1990 (38 A-633 – A-636);
- N. Quinn and M. Bruer, "A force directed component placement procedure for printed circuit boards," *IEEE Trans. Circuits and Syst.*, pp. 377-388, June 1979 (39 A-637 – A-648);
- Yang et al., "HALO: An Efficient Global Placement Strategy For Standard Cells," *IEEE Symp. Circuits and Systems*, © 1990 (40 A-649 – A-652);
- S. Goto, "An efficient algorithm for the two-dimensional placement problem in electrical circuit layout," *IEEE. Trans. Circuits Syst.*, CAS-28:12-18, Jan. 1981 (41 A-653 – A-659);
- Hartoog, "Analysis of Placement Procedures For VLSI Standard Cell Layout," *23rd Design Automation Conference, IEEE*, © 1986 (42 A-660 – A-665);
- Wipfler et al., "A Combined Force And Cut Algorithm For Hierarchical VLSI Layout," *19th Design Automation Conference, IEEE*, © 1982 (43 A-666 – A-672);
- K. Antreich, F. Johannes, and F. Kirsch, "A new approach for solving the placement problem using force models," *Proc. IEEE Intl. Symp. Circuits and Systems*, pp. 481-486, 1982 (44 A-673 – A-678);
- N. Quinn, "The placement problem as viewed from the physics of classical mechanics," *Proc. 12th Design Automation Conf.*, pp. 173-178, 1975 (45 A-679 – A-684);
- Goto et al., "Partitioning, Assignment and Placement," North-Holland, 1986 (46 A-685 – A-727);
- N. Sherwani, *Algorithms For VLSI Physical Design Layout*, © 1993 (47 A-728 – a-804); AND
- Sechen and A. Sangiovanni-Vincentelli. "The Timberwolf placement and routing package." *IEEE Journal of Solid-State Circuits*, SC-20(2):510--522, April 1985 (50 A-814 – A-826).
- Magma Design Automation Methodology Plan (13 A-83-112)
- Magma's Glossary (12 A-81-82)

6. Based on my review of his declaration, I find that Dr. Cooley agrees with me in

certain respects, but his conclusions do not follow from his observations. For example, his declaration demonstrates a fundamental misunderstanding of placement algorithms. A person of ordinary skill in the art would not reach the same conclusions as Dr. Cooley with regard to the proper interpretation of the claim terms at issue.

II. REQUISITE LEVEL OF SKILL IN THE ART.

7. In his declaration, Dr. Cooley provides opinions regarding what “one of ordinary skill in the art” would and would not have understood at the time of the filing of the ‘508 Patent in June of 1998. D.I. 143, ¶¶ 9-12. Indeed, many of Dr. Cooley’s opinions on claim construction are premised on his understanding of the level of ordinary skill in the art. However, Dr. Cooley makes no attempt to explain his understanding of the level of ordinary skill in the art, or even to define the “art” to which the ‘508 and ‘745 patents pertain. Therefore, all of the opinions set forth in Dr. Cooley’s declaration are incomplete in this regard. I maintain my opinion regarding the level of ordinary skill in the art as set forth in my Original Declaration. D.I. 141, Exhibit A, ¶¶ 9-10.

III. THE ‘508 PATENT

8. The novelty of the invention claimed in the ‘508 Patent lies in the use of certain types of logic modifications to provide opportunities for placement to improve congestion, without sacrificing area considerations. 1 A-1, Abstract; and 1 A-8, 5:45-57. Contrary to Magma’s arguments, the ‘508 Patent does not describe an improved placement algorithm. D.I. 145, p. 15. As explained later herein, an understanding of the novel aspects of the ‘508 Patent may assist the Court in resolving the proper scope of various claim terms in the ‘508 Patent.

9. The central theme presented by Magma on the ‘508 Patent is that Synopsys is trying to redraft a 1998 patent to apply to today’s technology. D.I. 145, p. 15. Specifically,

Magma devotes six pages of its Amended Markman Brief to building a theme suggesting that the placement steps (*e.g.*, “performing an initial placement” in claim 1, or “performing placement refinement” in claim 2) can be performed using a “min-cut” algorithm, but cannot be performed using a “force directed” algorithm. *Id.*, pp. 15 through 21. Initially, it should be noted that neither party has raised any claim construction issues pertaining to the scope of the “placement” steps in the claims of the ‘508 Patent. Magma does not make it perfectly clear why they are now focusing on these placement algorithms (*i.e.*, “force directed” and “min-cut” algorithms). However, from what I can gather, Magma appears to be arguing that some of the disputed claim terms (*i.e.*, “bin,” “bins” and “selected bins”) should be construed as Magma proposes because Magma believes its proposed constructions are consistent with “min-cut” algorithms, but not with “force directed” algorithms.

10. Magma’s arguments are based on the premise that the ‘508 Patent is aimed at an improved “min-cut” placement algorithm. This premise is a fallacy because the ‘508 Patent is completely agnostic with regard to placement algorithms. The ‘508 Patent devotes two sentences to teaching how the placement steps can be performed. 1 A-7, 3:30-35. The first sentence clearly conveys that the invention can be practiced using any “electronic design automation placement tool.” *Id.* As explained below, a person of ordinary skill in the 1998 time frame would have understood that the invention of the ‘508 Patent can be practiced using virtually any type of placement algorithm.

A. The Invention Of The ‘508 Patent

1. The Novel Aspects Of The Invention Claimed In The ‘508 Patent

11. The novelty of the invention claimed in the ‘508 Patent lies in a combination of steps, including: (1) performing certain type of “logic modifications” in one or more regions of

an integrated circuit; (2) performing the modifications “subject to limits on the increase in area”; and (3) performing placement refinement to improve congestion where opportunities are provided by the logic modifications. These aspects of the invention are well stated in the Abstract of the ‘508 Patent, which reads as follows:

This invention recognizes the ability of logic optimization to help placement relieve congestion. Different types of logic optimizations are used to help placement relieve congestion. In one type of optimization, the speed of parts of the circuit is improved by selecting faster cells. In another type of optimization, the topology of the circuit is changed such that placement can now move cells, which could not have been moved before, to reduce congestion and thus enable routing. A distinguishing feature of this methodology is that it not only uses the placement information for interconnection delay/area estimates during logic optimization, but also uses logic optimization to aid the physical placement steps by providing support to placement so that the congestion of the circuit is improved. The aim is to avoid getting into a situation where the placed circuit cannot be routed.

‘508 Patent, Abstract.

12. The Specification of the ‘508 Patent describes many different types of “logic optimizations” (also called “logic modifications”) that are designed to “help placement relieve congestion.” In fact, nine out of the twelve figures described in the ‘508 Patent describe logic optimizations that are designed to help placement relieve congestion. ‘508 Patent, Figures 3A-3C, 4A-4B, 5A-5B, and 6A-6B. Therefore, a person of ordinary skill in the art would have understood that the novelty of the invention claimed in the ‘508 Patent focuses primarily on these logic modifications, and their ultimate effect of reducing congestion. As Dr. Cooley observes, the term “congestion” appears 56 times in the nine pages of the ‘508 Patent. D.I. 143, ¶ 24. All of the claims include the term “performing logic modifications.” Nowhere in the patent does the word “min-cut” appear, nor is the patent restricted to any particular placement algorithm. Indeed, placement techniques are only mentioned in a few lines (*see* 1 A-7 3:31-35), while the vast majority of the Specification teaches how to perform the logic modifications that

allow placement to improve congestion. Therefore, the novelty of the '508 Patent lies in the performance of logic modifications that have the effect of reducing congestion, and not on any particular type of placement algorithm.

2. The Min-Cut Fallacy

13. In its brief, Magma repeatedly characterizes the '508 Patent as teaching an improvement to "min-cut" placement algorithms. First, Magma states that "Synopsys is trying to stretch a patent that provided an incremental improvement to outmoded technology (the "min-cut" system described below) to fit over modern 'force directed' congestion-reduction technology." D.I. 145, p. 15. Magma also states that "the '508 Patent is aimed at "min-cut systems" and "the '508 Patent's improvement to the min-cut system was rejected by industry." *Id.*, pp. 17 and 19. Magma even goes so far as to refer to the '508 Patent as the "min-cut patent." *Id.*, p. 17. These characterizations are way off the mark. The term "min-cut" is not even used in the '508 Patent, and the concept of it is not even alluded to. The '508 Patent can be used with any type of placement algorithm.

14. The term "min-cut" refers to a type of placement algorithm involving recursively partitioning cells based on the number of signals that cross the partition boundaries. 6 A-39. Magma's characterization of the '508 Patent as an "incremental improvement to ... 'min-cut'" is plainly wrong. The '508 Patent is not at all concerned with the min-cut algorithms, and the claimed inventions may be practiced using any type of placement algorithm. Rather, as explained above, the novelty of the invention claimed in the '508 Patent focuses on performing logic modifications to help placement improve congestion. *See, e.g.*, '508 Patent, Abstract (stating that "this invention recognizes the ability of logic optimization to help placement relieve congestion"). Magma acknowledges this core aspect of the '508 invention where it states that "[t]he central invention, however, remains simple: by exploring different ways to perform the

same logic operations, it may be possible to reduce congestion in particular bins on the chip.”

D.I. 145, p. 19.

3. The Invention Of The '508 Patent Can Be Practiced Using Any Type Of Placement Algorithm

15. Magma does not explain why it is arguing that the '508 Patent cannot be used with “force-directed” placement algorithms. The answer may lie in the fact that Magma’s electronic design automation (“EDA”) tools employ force directed placement algorithms. However, it has been explained to me that it is improper to consider the devices accused of infringement when determining the proper construction of claim terms.

16. As mentioned, the parties do not dispute the proper construction of the “placement” steps (*e.g.*, “performing an initial placement” in claim 1, or “performing placement refinement” in claim 2). However, Magma’s assertion that the invention applies to “min-cut” algorithms, and not “force-directed” algorithms, naturally calls into question the scope of the “placement” steps because the “min-cut” and “force-directed” algorithms are nothing more than methods for performing placement. Therefore, I have analyzed the Specification and claims of the '508 Patent as it concerns placement steps.

17. Each of the independent claims of the '508 Patent require “performing an initial placement” along with the key step of “performing logic modifications.” *See, e.g.*, '508 Patent at 6:50-51. Claims 2 and 13 both recite “performing placement refinement in an attempt to improve congestion by taking advantage of the logic modifications.” *See, e.g.*, '508 Patent at 6:58-60. None of the claims of the '508 Patent specify what type of “placement” algorithm must be used. However, as explained above, Magma argues that these “placement” steps must be done using “min-cut” algorithms, but that these steps cannot be performed using “force directed” algorithms. D.I. 145, p. 15. I disagree.

18. The '508 Patent does not require any particular type of placement algorithm for “performing an initial placement” or “performing placement refinement.” Virtually any type of placement algorithm can be used in conjunction with the step of “performing logic modifications” in order to practice and achieve the objectives of the invention claimed in the '508 Patent. Indeed, the '508 Patent states that:

The present invention may be used in conjunction with an electronic design automation placement tool. In accordance with an exemplary embodiment of one such placement tool, at each stage in cell placement, the cells are partitioned into a number of bins.

1 A-7 (3:31-35).

19. The first sentence in the above passage establishes that the invention may be used with any type of “electronic design automation placement tool.” Id. The second sentence describes an “exemplary embodiment” wherein “the cells are partitioned into a number of bins.” Id. I am confident that a person of ordinary skill in the art would interpret the Specification as teaching that virtually any type of placement algorithm can be used in the invention, and that one example is where “the cells are partitioned into a number of bins.” Id.

20. At the time the patent was filed, many placement systems had been used for a long time, including simulated annealing, evolution, min-cut, and force-directed placement. *See, e.g.,* 6 A-39 – A-50; and 47 A-736 – A-757. The min-cut algorithm uses partitioning, while the force-directed algorithm usually does not. *Id.* However, min-cut was not the only partitioning-based placement algorithm known at the time of the filing of the '508 Patent (*i.e.*, June 12, 1998). 47 A-742 – A-748. For example, simulated annealing and evolution algorithms can also use partitioning. *Id.* These techniques were covered in major textbooks including those by Michael Smith and Naveed Sherwani. *See, e.g.,* 6 A-39 – A-50; and 47 A-736 – A-757. Also, at the time of the filing of the '508 Patent, many EDA placement tools were available from various

vendors including Cadence Design Systems and Avant! Corporation. In addition, several universities provided freely available placement tools. *See, e.g.*, 50 A-814 – A-826.

3. Magma’s Argument That The Force-Directed Placement Algorithm Was Introduced In 1998 Is Irrelevant To The Present Claim Construction Issues, And It Is Also Blatantly False

21. Even more contrived than Magma’s characterization of the invention of the ‘508 Patent as an improved “min-cut” placement algorithm is Magma’s discussion of “force-directed” placement algorithms, and the publication by Eisenmann and Johannes. D.I. 145, pp. 17-18 citing Cooley Declaration (D.I. 143), Exh. B. My understanding is that the issue of whether or not the claims of the ‘508 Patent cover “force-directed” placement algorithms is a potential infringement issue. It is not a claim construction issue.

22. In addition, Magma’s suggestion that “force-directed” placement algorithms were first developed after the filing of the ‘508 Patent is blatantly false. Magma states:

The patent amply describes *Synopsys’s invention*. That invention, however, ***is not the force directed technology independently developed by Hans Eisenmann and Frank Johannes*** around the same time Magma filed its patent application.

D.I. 145, p. 14 (emphasis added)

23. Also, Magma’s expert, Edmond Cooley, states in his declaration that after the filing of the ‘508 Patent, Eisenmann and Johannes provided a “new and competing cell placement approach called the ‘Force-Directed’ technique.” D.I. 143, ¶ 15. This statement is very misleading because it suggests that force-directed placement was developed after the filing of the ‘508 Patent, which is not true. The following publications described force-directed placement two decades before the filing of the ‘508 Patent:

- N. Quinn and M. Bruer, “A force directed component placement procedure for printed circuit boards,” *IEEE Trans. Circuits and Syst.*, pp. 377-388, June 1979 (39 A-637 – A-648);

- N. Quinn, “The placement problem as viewed from the physics of classical mechanics,” *Proc. 12th Design Automation Conf.*, pp. 173-178, 1975 (45 A-679 – A-684);
- S. Goto, “An efficient algorithm for the two-dimensional placement problem in electrical circuit layout,” *IEEE. Trans. Circuits Syst.*, CAS-28:12-18, Jan. 1981 (41 A-653 – A-659);
- K. Antreich, F. Johannes, and F. Kirsch, “A new approach for solving the placement problem using force models,” *Proc. IEEE Intl. Symp. Circuits and Systems*, pp. 481-486, 1982 (44 A-673 – A-678); and
- Goto et al., “Partitioning, Assignment and Placement,” North-Holland, 1986 (46 A-685 – A-727).

B. Construction Of “Bins”

24. Synopsys has proposed that “bins” means “one or more regions,” while Magma has proposed that the same claim language means “more than one bin.” *See* Amended Final Joint Claim Chart (“AJCC”), Exh. B, pp. 1-3, 12-13. For all of the reasons described below, it is my opinion that Synopsys’ construction is correct.

1. The Applicants Defined “Bins” As “One Or More Regions”

25. The Applicants clearly defined “bins” to mean “one or more regions.” 1 A-8 (6:46-49). Each of the independent claims 1, 12, 15, 16, 17 and 18 of the ‘508 Patent recites in part, “to facilitate placement of circuit elements within ***one or more regions called bins*** on an integrated circuit design.” 1 A-8 – A-9 (emphasis added). Therefore, the claims specifically define “bins” to mean “one or more regions.” *Id.* This language was added by amendment during prosecution of the ‘508 Patent, and it was accompanied by a clear statement that “[b]y the present amendment, the claims would be amended to account for the possibility of ***performing the present invention using only a single bin (i.e., one encompassing the entire integrated circuit)*** as opposed to multiple bins.” 24 A-442 – A-445 (emphasis added). I note that Dr. Cooley did not address this statement in his justification for construing “bins,” nor did he list the

prosecution history on his list of materials considered.

26. Magma argues that “bins” must be plural because “the actual words of the claim are controlling in claims construction.” D.I. 145, p.24. But by this very reasoning, the actual words of the claim stating “one or more regions called bins” proves that bins means “one or more regions.”

2. The Specification Supports The Definition Of “Bins” As Meaning “One Or More Regions”

27. The specification teaches that “the present invention may be used in conjunction with an electronic design automation placement tool.” 1 A-7, 3:31-32. Some placement tools divide the placement area into multiple bins, while others do not. The Specification never limits the invention to placement tools that use multiple bins. Rather, it describes use of the invention with multiple bins as just “an exemplary embodiment”:

The present invention may be used in conjunction with an electronic design automation placement tool. In accordance with an exemplary embodiment of one such placement tool, at each stage in cell placement, the cells are partitioned into a number of bins.

1 A-7 (3:31-35).

28. Moreover, the Specification teaches the use of “intra-bin pin density logic optimization” that is done on “gates in a bin.” 1 A-8, 5:1-3. These optimizations operate on cells in a single bin. The Specification also teaches the use of “inter-bin logic optimization” that reduces pin density in a congested bin by possibly increasing it in a less congested bin. 1 A-8, 5:13-14. By making this distinction, the Specification shows that there are some logic modifications that the invention can be performed on a single bin (including one encompassing the entire integrated circuit) and others that can be used when the chip is divided into multiple bins.

29. Magma argues that intra-bin logic modifications would not “make sense if the

inventors had contemplated having a single bin.” D.I. 145, p.24. I fail to follow their reasoning; logic modifications inside the bin make perfect sense if the invention operates on a single bin.

30. Magma also argues that multiple bins are needed because the patent discloses only one method for calculating congestion: the number of pins in a bin divided by the routable area of the bin. D.I. 145, p. 24. As I have already explained in my previous Declaration, the patent also discloses the Interconnect Model method for calculating congestion. Original Declaration, ¶¶ 55-58. This method is perfectly consistent with placing all cells in open bin encompassing the entire integrated circuit. By ignoring this congestion calculation method, Magma seeks to reach the faulty conclusion that the chip must have multiple bins despite explicit claim language to the contrary.

C. Construction Of “Selected Bins”

31. Magma proposes to construe “selected bins” as “more than one bin selected based on congestion” while Synopsys proposes “one or more selected regions.”

32. “Selected bins” has a plain and ordinary meaning once the term “bins” is clear. The further limitation Magma seeks to inject - “selected based on congestion” - is not present in the plain and ordinary meaning of the claim term. Magma imports this limitation from one of the embodiments in the Specification. But as Magma notes, and as it is my understanding as well, it is “improper to import limitations from the specification into the claims, or to limit construction of a term to the preferred embodiment.” D.I. 145, p. 12.

33. In my experience, there could be many reasons to select a bin for logic modification, including timing, density, power consumption, and congestion. The Specification explicitly calls out “identification of critical paths and/or congested circuits” as two reasons for selecting elements of the chip for modification. 1 A-7, 3:61. There is no justification in the

Specification for altering the plain and ordinary meaning of “selected bins” to limit the term to selection based on congestion.

D. Construction Of “Bin”

34. Synopsys and Magma disagree about the construction of the term “bin.” Magma incorrectly states that the term “bin” was not defined in the ‘508 Patent, and that therefore extrinsic evidence is appropriate. However, the language of the claim states “one or more regions called bins.” 1 A-8, 6:47-48. This unambiguously indicates that a “bin” is a “region.”

35. Dr. Cooley has opined that “the ‘508 Patent does not describe a bin, and there is no definition of a ‘bin’ anywhere in the ‘508 Patent.” D.I. 143, ¶ 8. This opinion ignores the claim language, which explicitly defines the term “bins.”

36. Dr. Cooley and Magma instead propose a construction based on extrinsic evidence. As Magma notes, and as it is my understanding as well, explains “extrinsic evidence is less valuable than the patent and its prosecution history ... because extrinsic evidence lends itself to being divorced from the patent and its claims.” D.I. 145, p. 6. Magma’s proposed construction has exactly this weakness against which they caution. Magma’s proposed construction adds several limitations that are not contained in the patent.

37. Magma cites a number of articles and patents to support its proposed construction of “bin” as being limited to “a rectangular (or square) portion of an integrated circuit bounded by gridlines.” D.I. 145 at 21-22 citing Joint Appendix, Exhs. 25-27 and 33. For example, Magma cites the ‘743 patent. *Id.* However, this patent uses the term “bins” in a context that is different from the context of the claims of the ‘508 Patent. The ‘743 patent specifies a “recursive quadrisection” process in which each bin is divided into four bins. 27 A-490 at 2:40-42. The ‘508 Patent does not require or even mention a quadrisection process. While a quadrisection

process may require a "grid," the term "bin" does not. Magma cites to portions of three other references as extrinsic evidence on the term "bin." (D.I. 145, pp. 21-23). All of the passages Magma cites refer specifically to a "grid" or "grids." *Id.* A person of ordinary skill in the art would understand that while a grid *may* be used to define "bins," it is not *necessary* to use a grid to define bins. Because the term "grid" does not even appear in the Specification of the '508 Patent, I see no basis for limiting the term "bin" to "a rectangular (or square) portion of an integrated circuit bounded by gridlines," as Magma has proposed. Without the requirement of a grid, a person of ordinary skill in the art would understand the term "bin," as recited in the '508 patent claims, to mean a region of an integrated circuit. My understanding is that a person of ordinary skill in the art would understand a "bin" to be a region of an integrated circuit.

38. Moreover, Magma's construction contains the word "portion," which implies that a bin cannot contain the entire chip. This would be inconsistent with the file history, which states "[b]y the present amendment, the claims would be amended to account for the possibility of performing the present invention using only a single bin (*i.e. one encompassing the entire integrated circuit*) as opposed to multiple bins." 2 A-14 (emphasis added).

E. Construction Of "Limits"

39. Magma fails to construe the term "limits" in light of the specification. On claims term such as "selected bins," Magma has sought to unreasonably narrow the construction of a term by choosing a particular embodiment in the Specification. On this claim term, Magma makes the opposite error, seeking to unreasonably narrow the construction of the term by ignoring the Specification.

40. The preferred embodiment in the specification states that "the proposed logic optimizations are only allowed to increase the bin area to the upper bound." 1 A-8, 5:66-6:1. In

this embodiment, there is only one upper bound on the bin area, not more than one.

41. If Magma's construction of "limits" as "more than one upper bound" were adopted, the claims would be inconsistent with the preferred embodiment. I understand that claim terms must be construed in light of the specification. I agree with Synopsys's construction of "limits" as "upper bounds" because it is consistent with the embodiment in the specification.

F. Construction Of The "Improving Congestion" Terms

42. Two of the claim terms at issue involve "improving congestion." The parties' positions on these two claim terms (hereinafter referred to as the "Improving Congestion Terms") are summarized below.

'508 Claim Language	Synopsys' Proposed Construction	Magma's Proposed Construction
to allow congestion of the placement to be improved (Claims 1-11, 15, 17)	to provide opportunities for placement to improve congestion. (AJCC, Exh. B, p. 13)	<i>with the purpose of reducing congestion</i> of the placement. (AJCC, Exh. B, p. 13) (Emphasis Added).
in an attempt to improve congestion by taking advantage of the logic modifications (Claims 2-11, 13, 14)	to relieve congestion where opportunities are provided by logic modifications. (AJCC, Exh. B, p. 3.)	<i>with the purpose of reducing congestion</i> by taking advantage of more than one logic modification. (AJCC, Exh. B, p. 3) (Emphasis Added).

43. The constructions proposed by Synopsys and Magma both involve improving (or reducing) congestion. However, Magma's proposed constructions inject the extraneous limitation of a "*purpose* of reducing congestion" into these two claim terms, while Synopsys' proposed constructions simply recognize the *effect* of reducing congestion. The distinction between "purpose" and "effect" is not insignificant.

44. A computer program is not a sentient being. It does not perform steps with intent or purpose. It only has an effect or result. It is apparent that Magma seeks to inject a "purpose" limitation into Improving Congestion Terms because Magma knows it is difficult to prove that a

computer program carries out a series of steps for any particular purpose. On the other hand, one can analyze a computer program to ascertain the effect of the various steps carried out by the computer program.

45. These Improving Congestion Terms appear in the claims of the '508 Patent as follows:

- “subject to limits on the increase in area of integrated circuit elements within a bin, performing logic modifications within selected bins of the integrated circuit design to allow congestion of the placement to be improved” (1 A-8) (claim 1);
- “performing placement refinement in an attempt to improve congestion by taking advantage of the logic modifications” (1 A-8) (claim 2); and

1 A-8 - A-9 (emphasis added on disputed language).

46. Magma cites the following portions of the Specification of the '508 Patent:

- This invention recognizes the ability of logic optimizations to help placement relieve congestion. (Joint App., Ex. 1 at A-6, 2:21-22, emphasis added.)
- This invention will significantly reduce, if not eliminate, the iterations needed by considering not only the impact of interconnect during logic optimization of area/timing, but also at the same time doing logic optimizations to help placement relieve congestion and thus generate a circuit that is easily routable. (Joint App., Ex. 1 at A-8, 6:30-35, emphasis added.)
- Rather, the approach of the present invention is to first reduce signal delays using conventional logic optimization techniques. This reduction in the signal delays provides additional slack that can then be used by a subsequent placement step to relieve congestion. (Joint App., Ex. 23 (Response) at A-427, emphasis added.)
- In the present invention, congestion is addressed through logic modification. (Id. at A-426)

47. While the above portions of the Specification draw connections between “logic modification,” “placement” and “reliev[ing] congestion,” there is no mention of performing logic modification or placement with a “purpose” or intent. I agree that the claims including the Improving Congestion Terms require an effect of reducing congestion. But I do not believe that the steps of performing logic modifications or placement need to be performed with any sort of

intent or “purpose.”

G. Construction Of The “Reducing Constraints” Term

48. Another term at issue involves “reducing constraints.”

‘508 Claim Language	Synopsys’ Proposed Construction	Magma’s Proposed Construction
reducing constraints on a subsequent placement step (Claims 12-14, 16, 18)	reducing more than one constraint on a subsequent placement step.	reducing more than one constraint on a subsequent placement step <i>with the purpose of reducing congestion</i> during the subsequent placement step.

49. I understand that Synopsys has amended its construction of “reducing constraints on a subsequent placement step” to “reducing more than one constraint on a subsequent placement step.” Synopsys’ revised construction is identical to Magma’s except that Magma inserts an additional limitation of “with the purpose of reducing congestion during the subsequent placement step.”

50. Magma improperly applies the same analysis to the disputed claim language “reducing constraints on a subsequent placement step” as it applies to the two Improving Congestion Terms discussed above. D.I. 145, pp. 26-27. In a similar manner, Magma interprets the phrase “reducing constraints on a subsequent placement step” to require the limitation “**with the purpose of reducing congestion.**” *Id.* However, unlike the two Improving Congestion Terms, the claim language “reducing constraints on a subsequent placement step” does not even recite the word “congestion.”

51. To support its proposed construction of “reducing constraints on a subsequent placement step,” Magma cites to the same passages in the Specification that discuss “congestion.” D.I. 145, p. 28. However, the “constraints” referred to in the phrase “reducing constraints on a subsequent placement step” may be timing constraints. The ‘508 Patent

specification explains that “such timing improvement is desirable in and of itself.” 1 A-7, 4:2-3.

52. Magma seeks to add the “purpose” limitation to narrow the claim more tightly than the plain language of the claim and the Specification indicate. The claim itself says that the purpose of making “logic modifications [that] improve timing” is simply to “reduce[e] constraints on a subsequent placement step.”

53. Magma also argues that “logic modifications for the purpose of improved timing were well-known in the prior art,” and that therefore the ‘508 patent is limited to its novel feature: reducing congestion. D.I. 145, p. 29. I agree that logic modifications for the purpose of improving timing were well-known at the time of the invention. However, I am not aware of prior art that imposed “limits on the increase in area” while making those logic modifications to improve timing, as set out in claim 12 of the ‘508 Patent. 1 A-9. This claim limitation distinguishes the claim from the prior art; there is no need to add the unwritten limitation of “with the purpose of reducing congestion” to make the invention novel.

H. “Means for Calculating Congestion of the Initial Placement”

54. The phrase “means for calculating congestion of the initial placement” appears in claims 17 and 18 of the ‘508 Patent. 1 A-9 at 8:36 and 8:53. I understand that the parties agree that the claimed function is “calculating congestion of the initial placement.” AJCC, Exh. B, pp.

7. Synopsys has proposed that the corresponding structure be construed as follows:

(a) a computer executing an algorithm for calculating congestion for the initial placement in accordance with an algorithm that calculates the total number of pins in the bin divided by the total routable area in the bin (1 A-7 at 4:61-67); and

(b) a computer executing an algorithm for calculating congestion for the initial placement using interconnection models for interconnects between bins or within bins (1 A-7 at 3:35-38).

55. I understand that Magma agrees that the first above-identified structure

corresponds with the “means for calculating congestion of the initial placement.” AJCC, Exh. B, pp. 7-8. Therefore, the only dispute I am aware of concerning this phrase is whether or not the second above-identified structure (hereinafter referred to as the “Interconnect Model Algorithm”) also corresponds with this claim limitation.

56. The Specification of the '508 Patent links the description of the Interconnect Model Algorithm to the claimed function of “calculating congestion of the initial placement” where it states that “[i]nterconnection models for interconnects between bins and within bins provide both delay estimates for each interconnect in the circuit, as well as congestion estimates for each bin in the circuit.” (1 A-7 at 3:35-38). This portion of the Specification conveys to a person of ordinary skill in the art that the claimed function of “calculating congestion of the initial placement” can be achieved using the Interconnect Model Algorithm.

57. Magma argues that a computer “calculating congestion for the initial placement using interconnection models for interconnects between bins or within bins” is not a corresponding structure for this function. D.I. 145, pp. 32-33. Magma is vague about the objection, stating “these disclosure [sic] points to a class of models and does not specify any corresponding structure act or algorithm.” *Id.*, p. 33.

58. In my opinion, it would have been clear to a person of ordinary skill in the art that “interconnection models for interconnects between bins and within bins provide both delay estimates for each interconnect in the circuit, as well as congestion estimates for each bin in the circuit” describes a way to calculate congestion. 1 A-7, 3:35-38. Moreover, the Specification of the '508 Patent explicitly states that the invention can be embodied in a computer that implements the methods. 1 A-8, 6:3-11. I cannot understand why a computer programmed to use interconnect models to calculate congestion would not be a disclosed structure for this function.

59. As mentioned in my original declaration, global routing is a common example of the Interconnection Model Algorithm for computing congestion. Original Decl., ¶ 57. Global routing creates a model representing the approximate location of interconnects, which indicates the portions of the chip that are congested. *Id.* Michael Smith's well-known Application Specific Integrated Circuits textbook (1997) shows examples of interconnection models being used to compute congestion during floorplanning. 33 A-537 – A-539. In one case, the interconnections are modeled as a rat's nest of flight lines between connectors and this model is used to determine and improve congestion. In another case, congestion is computed based on the channel density, which is a model of how many interconnects will pass through a particular routing channel.

I. “Means For Performing An Initial Placement”

60. Claims 17 and 18 of the '508 Patent both recite “means for performing an initial placement of integrated circuit elements within bins on the design layout.” (1 A-9 at 8:34-35 and 8:48-50). I understand that Synopsys and Magma agree that the claimed function is “performing an initial placement of integrated circuit elements within bins on the design layout.” AJCC, Exh. B, pp. 8-10. As I understand the situation, the only dispute with respect to this phrase concerns its disclosed corresponding structure. Specifically, Magma argues that there is no corresponding structure disclosed in the Specification. AJCC, Exh. B, pp. 8-10. On the other hand, Synopsys has identified the following structures corresponding with the “means for performing an initial placement of integrated circuit elements within bins on the design layout”:

- an electronic design automation placement tool (1 A-7 at 3:30-31);
- a computer executing an algorithm for placing cells in one or more regions using a placement tool that partitions cells into one or more regions at each stage of the placement (1 A-7 at 3:31-35); and
- a computer executing an algorithm for placing cells in accordance with a placement

algorithm that is limited by the topology of the circuit (1 A-7 at 4:23-29).

61. I disagree with Magma's assertion that there is no structure in the Specification of the '508 Patent that corresponds with the "means for performing an initial placement of integrated circuit elements within bins on the design layout." AJCC, Exh. B, pp. 8-10. The specification of the '508 Patent explains that the function of "performing an initial placement of integrated circuit elements within bins on the design layout" may be performed as follows:

The present invention may be used in conjunction with an electronic design automation placement tool. In accordance with an exemplary embodiment of one such placement tool, at each stage in cell placement, the cells are partitioned into a number of bins.

1 A-7 at 3:31-35.

62. A person of ordinary skill in the art would understand the above statement that "the present invention may be used in conjunction with an electronic design automation placement tool" to mean that the claimed function of "performing an initial placement of integrated circuit elements within bins on the design layout" may be performed using any electronic design automation ("EDA") placement tool. At the time of the filing of the '508 Patent (*i.e.*, June 12, 1998), many EDA placement tools were available from various vendors including Cadence Design Systems and Avant! Corporation. Currently, Synopsys and Magma both sell EDA placement tools. At the time of filing, there were also several freely available placement tools published by universities, including Timberwolf. *See, e.g.*, 50 A-814 – A-826. The well-known textbook by Naveed Sherwani (*Algorithms for VLSI Physical Design Automation*, 1993) describes numerous algorithms for placement, including simulated annealing, force directed placement and partitioning based placement. 47 A-736 – A-757. Michael Smith's *Application Specific Integrated Circuits* textbook also describes these methods. 6 A-39 – A-50. Any of these well-known tools or algorithms could be used for initial placement.

63. The Specification of the '508 Patent also explains that "[i]n accordance with an

exemplary embodiment of one such placement tool, at each stage in cell placement, the cells are partitioned into a number of bins.” 1 A-7 at 3:31-35. A person of ordinary skill in the art would understand this portion of the Specification as describing a well-known class of algorithms for performing the claimed function of “performing an initial placement of integrated circuit elements within bins on the design layout.” For example, Michael Smith’s well known text book on Application-Specific Integrated Circuits explains:

The min-cut placement method uses successive application of partitioning [Breuer, 1977]. The following steps are shown in Figure 16.24:

1. Cut the placement area into two pieces.
2. Swap the logic cells to minimize the cut cost.
3. Repeat the process from step 1, cutting smaller pieces until all the logic cells are placed.

Usually we divide the placement area into bins. The size of a bin can vary, from a bin size equal to the base cell (for a gate array) to a bin size that would hold several logic cells. We can start with a large bin size, to get a rough placement, and then reduce the bin size to get a final placement.

(6 A-39 - A-40).

64. The Specification of the ‘508 Patent describes a very specific algorithm where it states “**at each stage** in cell placement, the cells are partitioned into a number of bins.” 1 A-7 at 3:31-35 (emphasis added). A person of ordinary skill in the art would understand this passage to describe an iterative “partitioning” process. This exemplary embodiment is just one structure for carrying out of the broadly claimed function.

IV THE ‘745 PATENT

65. I understand that two of the terms at issue in the ‘745 Patent are “buckets” and “congestion score.”

A. Construction of “buckets”

66. I understand that Magma wishes to construe the term “bucket” as “a coarse, rectangular region within the chip’s core.” Synopsys’ proposed definition is “rectangular, coarse placement region within the chip’s core.” The primary difference between the two definitions is that Magma omits the word “placement” from its proposed construction.

67. I reviewed the specification of the ’745 patent to understand how the word “bucket” is used in the context of the ’745 patent. The specification teaches that, “[m]ore specifically, the core 400 where the cells are placed is divided into coarse placement regions called buckets 410 as shown in FIG. 4. Each bucket 410 is a small rectangular region within the core 400.” 8 A-66 (6:47-50). Magma uses only part of this definition in its proposed construction of “bucket”: e.g., “coarse” and “rectangular,” but not “placement.”

68. One critical error in Magma’s proposed construction of the term “buckets” is that Magma’s proposal, which omits the word “placement,” separates the words “coarse placement.” “Coarse placement” is a technical term of art indicating a placement process that assigns cells to buckets on a chip rather than to exact locations. This is clear from the ’745 patent, which uses the term “coarse placement” in several places. See, e.g., 8 A-68 (10:2-3, 10:10). Magma’s own internal documents also use the term “coarse placement.” See 12 A-81; 13 A-98. The “coarse placement regions called buckets” at 6:48 refer to these buckets used in coarse placement. Magma keeps the word coarse but discards the word placement, changing the meaning of the sentence. This would be analogous to taking a definition “stainless steel rods called driveshafts” and using it to construe “driveshafts” as “stainless rods.” Separating the words “coarse” and “placement” changes the meaning of the phrase.

B. Construction of "congestion score"

69. Magma proposes to construe "congestion score" as "a ratio measure of routing resources" while Synopsys proposes "the ratio of routing resources used so far to the total routing resources available."

70. Specifically, the use of "congestion score" in Claim 2 is backward from the way it is defined in the Specification. In my opinion, anyone of ordinary skill in the art would understand that claim 2 is garbled, rather than being an attempt to introduce another definition of "congestion score." I have never seen the term "congestion" used as it is used in claim 2. For a chip designer to say that a bucket is "congested" when most of the wire routing spaces are available would be analogous to a traffic reporter saying that the road is "congested" when most of the lanes are available; it is simply nonsense.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

EXECUTED on 17 November, 2006



David Harris, Ph.D.

EXHIBIT B

**IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE**

SYNOPSYS, INC., a Delaware Corporation,)	C.A. No. 05-701 GMS
)	
)	
Plaintiff and)	
Counter-Defendant,)	
)	
v.)	
)	
MAGMA DESIGN AUTOMATION,)	
a Delaware Corporation,)	
)	
Defendant and)	
Counterclaimant.)	
_____)	
)	
AND RELATED COUNTERCLAIMS.)	
_____)	

**MAGMA DESIGN AUTOMATION'S
PROPOSED TERMS AND CLAIM ELEMENTS FOR CONSTRUCTION**

United States Patent No. 6,505,328:

- Active memory
- Adapted
- All of the above objects describe
- Area query
- Associated
- Common data model
- Data representation
- Disk storage
- Logically correlated
- Maintained
- Net
- Netlist
- Pins
- Placement
- Together represent

United States Patent No. 6,519,745:

- Bucket
- Congestion score
- Estimating a capacitance
- Estimating a spacing
- Spacing configuration

United States Patent No. 6,854,093:

- Abutted-pin
- Block-level
- Hierarchical physical design
- Netlist

- Placement
- Pressing
- Properties
- Shape operation
- Top-level


United States Patent No. 6,857,116:

- Abutted-pin
- Block-level
- Congested blocks
- Hierarchical physical design
- Locations of obstructions
- Netlist
- Pin assignments
- Placement
- Ports
- Said obstruction includes a random access memory (RAM)
- Pressing
- Top-level

United States Patent No. 6,192,508:

- Bin
- Facilitate placement of circuit elements within one or more regions called bins
- Fanout/fanin
- Gate
- In an attempt to improve congestion by taking advantage of the logic modifications
- Initial placement
- Limit
- Logic modification

- Logically equivalent
- Means for calculating congestion of the initial placement
- Means for performing an initial placement of integrated circuit elements within bins on the design layout
- Means for, subject to limits on the increase in area of integrated circuit elements within a bin, performing logic modifications within selected bins of the integrated circuit design
- Modifying logic
- Net
- Netlist
- Pin
- Placement
- Reducing constraints on a subsequent placement step
- Selected bins
- Selected nets belonging to the selected bins
- Subject to limits on the increase in area of integrated circuit elements within a bin
- Timing slack
- To allow congestion of the placement to be improved



James Pooley (ipooley@pooleyoliver.com)

L. Scott Oliver (soliver@pooleyoliver.com)

Marc D. Peters (mdpeters@pooleyoliver.com)

Pooley & Oliver LLP

Five Palo Alto Square, 7th Floor

Palo Alto, CA 94306-2121

(650) 739-7020

William J. Marsden, Jr., Esq.

marsden@fr.com

Fish & Richardson P.C.

919 N. Market Street

P.O. Box 1114

Wilmington, DE 19899-1114

Telephone: (302) 652-5070

Facsimile: (302) 652-0607

Attorneys for Defendant and Counterclaimant,

Magma Design Automation, Inc.

Katherine Kelly Lutton, Esq.

Tamara Fraizer, Esq.

Fish & Richardson, P.C.

500 Arguello St., suite 500

Redwood City, CA 94063

DATED: September 13, 2006

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that on September 13, 2006, I served the foregoing document on counsel of record in the manner indicated.

VIA ELECTRONIC MAIL & U.S. MAIL

Valerie M. Wagner, Esq.
Dechert LLP
1117 California Avenue
Palo Alto, CA 94304

Karen Jacobs Loudon, Esq.
1201 North Market Street
P.O. Box 1347
Wilmington, DE 19899



L. Scott Oliver

EXHIBIT C

THE AMERICAN HERITAGE
DICTIONARY
OF THE ENGLISH LANGUAGE

DICTIO

W

P

F

A

THE AMERICAN HERITAGE DICTIONARY OF THE ENGLISH LANGUAGE

VILLIAM MORRIS, Editor

published by

HOUGHTON MIFFLIN COMPANY / BOSTON
ATLANTA / DALLAS / GENEVA, ILLINOIS / HOPEWELL, NEW JERSEY / PALO ALTO

endix*)
t-ly adv.
k-witted
sons and
ness. In-
demands
y what
ning and
ometimes
cuteness
specially
ernment
itness of
g mental
nowledge,
s, some-
tress the
ose who
intellec-
a, from
ce, from
2. Capa-
ble Eng-
ive. See
ce, as in
oderate
To have
destine
have in
en, from
toward,
end (see
by that
call her
endant;
tion or
The dis-
dminis-
e mon-
f Latin
instru-
lere, to
respect
use. In-
tentio
ire. To
DER +
ame in
strain.
[Mid-
etched
oward
2. An
make of
ore in-
noted
tin in-
at con-
ure of
it test
t time
ation.
harab
inter-
Con-
ng for
hysics.
namio
ic ele-
se but
Latin
rpose.
ction.
ms at
g the
stened
Old
terna-
D.]
esign-
ose in
I lid,
dish/

regard to marriage: *honorable intentions*. 3. The general connotation or concept of something; what something is meant to convey. 4. *Medicine*. The course or manner of healing of a surgical wound. 5. *Archaic*. The import; meaning. 6. *Archaic*. Intention. [Middle English *entencoun*, from Old French *entencion*, from Latin *intentiō*, "a stretching out," from *intendere*, to stretch toward, *INTEND*.]

Synonyms: *intention, intent, purpose, object, goal, end, aim, objective*. These nouns refer to what one hopes to achieve or attain. *Intention* signifies a course of action that one proposes to follow. *Intent*, often a legal term, more strongly implies a fixed course pursued deliberately, and *purpose* adds to this the idea of resolution or determination to carry out what one proposes. *Object* and *goal* are sometimes interchangeable in referring to the proposed attainment. *Object*, however, often implies something clearcut and attainable by practical means, and *goal* something more idealistic or remote. *End* suggests an ultimate attainment, viewed from long range, and *aim*, the direction one's efforts take in pursuit of the end. *Objective* refers to an end or goal with the implication that it can be reached.

in-tention-al (in-tén'shə-nəl) *adj.* 1. Done deliberately; intended: *an intentional slight*. 2. Having to do with logical intention or connotation. —See *Synonyms at voluntary*. —**in-tention-al-ly** (in-tén'shə-nəl-ē) *adv.* **in-ter** (in-tūr) *tr.v.* -tered, -tering, -ters. To place in a grave; bury. [Middle English *entere*, from Old French *enterrer*, from Vulgar Latin *interrire* (unattested): Latin *in*, in + *terra*, earth, ground (see *ters* in Appendix*.)]

inter-. Indicates: 1. Between or among; for example, *intercollegiate*, *international*. 2. Mutually or together; for example, *interact*, *intermingle*. **Note:** Many compounds other than those entered here may be formed with *inter-*. In forming compounds, *inter-* is normally joined with the following element without space or hyphen: *interregnum*. However, if the second element begins with a capital letter, it is separated with a hyphen: *inter-American*. Note that in Latin phrases used in English, the Latin preposition remains a separate word: *inter alia*. [Middle English *inter*, *entre*, from Old French, from Latin *inter*, from *inter*, between, among. See *on* in Appendix* In borrowed Latin compounds, *inter-* indicates: 1. Between, among, as in *interregnum*. 2. Mutually, each other, as in *intersect*. 3. At intervals, as in *intermit*. 4. Preventively, destructively, as in *interdict*, *intercine*.]

inter, intermediate.
in-ter-act (in'tər-äkt') *tr.v.* -acted, -acting, -acts. To act on each other. —**in-ter-ac-tion** *n.* —**in-ter-ac-tive** *adj.*

in-ter-a-li-a (in'tər ä'lē-ə) *Latin*. Among other things.

in-ter-a-li-os (in'tər ä'lē-ös') *Latin*. Among other persons.

in-ter-brain (in'tər-brän') *n.* The diencephalon.

in-ter-breed (in'tər-bréd') *v.* -bred (-bréd'), -breeding, -breeds. —*intr.* 1. To breed with another kind or species; crossbreed; hybridize. 2. To breed within a narrow range or with closely related types or individuals; inbreed. —*tr.* To cause to interbreed.

in-ter-ca-lar-y (in-tūr-kə-lər-ē) *adj.* 1. Added to the calendar to make the calendar year correspond to the solar year. Said of a day or a month. 2. Having such a day or month added. Said of a year. 3. Interpolated. [Latin *intercalārius*, from *intercalāre*, to intercalate.]

in-ter-ca-late (in-tūr-kə-lāt') *tr.v.* -lated, -lating, -lates. 1. To add (a day or month) to a calendar. 2. To insert, interpose, or interpolate. [Latin *intercalāre*, to proclaim the insertion of a day: *inter*, among, between + *calāre*, to call (see *kel*-3 in Appendix*.)] —**in-ter-ca-la-tion** *n.* —**in-ter-ca-la-tive** *adj.*

in-ter-cede (in'tər-séd') *tr.v.* -ceded, -ceding, -cedes. 1. To plead on another's behalf. 2. To act as mediator in a dispute. [Latin *intercedere*, to come between: *inter*, between + *cedere*, to go (see *ked*-1 in Appendix*.)] —**in-ter-ced'er** *n.*

in-ter-cel-lu-lar (in'tər-sél-yə-lər) *adj.* Among or between cells.
in-ter-cept (in'tər-sépt') *tr.v.* -cepted, -cepting, -cepts. 1. To stop, deflect, or interrupt the progress or intended course of. 2. *Obsolete*. a. To cut off from access or communication. b. To prevent. 3. To intersect. 4. *Mathematics*. To cut off or bound a part of (a line, plane, surface, or solid). —*n.* (in'tər-sépt') *Mathematics*. The distance from the origin of coordinates along a coordinate axis to the point at which a line, curve, or surface intersects the axis. [Latin *intercipere* (past participle *interceptus*), to intercept, seize in transit: *inter*, preventively + *capere*, to take, seize (see *kap*- in Appendix*.)] —**in-ter-cep-tive** *adj.*

in-ter-cep-tor (in'tər-sépt-ər) *n.* Also **in-ter-cep-ter**. 1. One that intercepts. 2. A fast-climbing, highly maneuverable fighter plane designed to intercept enemy aircraft.

in-ter-ces-sion (in'tər-sesh'ən) *n.* 1. Entreaty in favor of another. 2. Mediation in a dispute. [Old French, from Latin *intercessiō*, from *intercedere* (past participle *intercessus*), *INTER-CEDE*.] —**in-ter-ces-sion-al** *adj.* —**in-ter-ces-sor** (-sés'ər) *n.* —**in-ter-ces-so-ry** *adj.*

in-ter-change (in'tər-chānj') *v.* -changed, -changing, -changes. —*tr.* 1. To switch each of (two things) into the place of the other. 2. To give and receive mutually; to exchange. 3. To cause to succeed each other; to alternate. —*intr.* 1. To change places with each other. 2. To succeed each other; to alternate. —*n.* (in'tər-chānj'). 1. The act or process or an instance of interchanging, especially: a. A switch of places. b. An exchange. 2. Alternation. 3. A highway intersection designed to permit traffic to move freely from one road to another. [Middle English *entrenchangen*, from Old French *entrenchangier*: *INTER-* + *changier*, to CHANGE.] —**in-ter-chang'er** *n.*

in-ter-change-a-ble (in'tər-chān'jə-bəl) *adj.* Capable of mutual interchange; admitting transposition. —**in-ter-change-a-bil'i-ty**, **in-ter-change-a-ble-ness** *n.* —**in-ter-change-a-bly** *adv.*

in-ter-col-le-giate (in'tər-kə-lē'jīt, -jē-īt) *adj.* Involving or representing two or more colleges.

in-ter-co-lum-ni-a-tion (in'tər-kə-lūm-nē-ā'shən) *n.* 1. The open spaces between the columns in a colonnade. 2. The system whereby they are spaced.

in-ter-com (in'tər-kōm') *n.* An intercommunication system, as between two rooms. [Short for *INTERCOMMUNICATION*.]

in-ter-com-mu-ni-cate (in'tər-kə-myōō'nə-kāt') *intr.v.* -cated, -cating, -cates. 1. To communicate with each other. 2. To be connected or adjoined, as rooms. —**in-ter-com-mu-ni-ca-tion** *n.* —**in-ter-com-mu-ni-ca-tive** *adj.*

in-ter-con-nect (in'tər-kə-nēkt') *v.* -nected, -necting, -nects. —*intr.* To be connected one to the other. —*tr.* To connect (one thing with another). —**in-ter-con-nec-tion** *n.*

in-ter-con-ti-nen-tal (in'tər-kōn'tə-nēnt'l) *adj.* 1. Extending from one continent to another: *intercontinental flight*. 2. Waged between continents: *intercontinental warfare*. 3. Capable of flight from one continent to another: *intercontinental ballistic missile*.

in-ter-con-ver-sion (in'tər-kən-vūr'zhən, -shən) *n.* Mutual conversion. —**in-ter-con-vert-i-ble** *adj.*

in-ter-cos-tal (in'tər-kōst'l) *adj.* Located or occurring between the ribs. [New Latin *intercostalis*: Latin *inter*, between + *costa*, rib (see *kost*- in Appendix*.)]

in-ter-course (in'tər-kōrs', -kōrs') *n.* 1. Interchange between persons or groups; communication. 2. Coitus. [Middle English *intercourse*, from Old French *entrecours*, from Latin *intercursus*, past participle of *intercurrere*, to run between: *inter*, between + *currere*, to run (see *kars*-2 in Appendix*.)]

in-ter-crop (in'tər-krōp') *v.* -cropped, -cropping, -crops. —*intr.* To grow a secondary crop between the rows of a principal crop. —*tr.* To plant such a crop on. —*n.* A secondary crop grown between the rows of a principal crop.

in-ter-cur-rent (in'tər-kūr-ənt) *adj.* 1. Occurring as an interruption in a process. 2. *Pathology*. Occurring during the course of an existing disease. [Latin *intercurrēns*, present participle of *intercurrere*, to run between. See *intercourse*.]

in-ter-den-tal (in'tər-dēnt'l) *adj.* 1. Located between the teeth. 2. *Phonetics*. Pronounced with the tip of the tongue protruding between the teeth, as (*th*) in *that* or (*th*) in *thumb*. —*n.* *Phonetics*. A consonant pronounced in this manner.

in-ter-dict (in'tər-dikt') *tr.v.* -dicted, -dicting, -dicts. 1. To prohibit or place under an ecclesiastical or legal sanction. 2. To cut or destroy (an enemy line of communication) by firepower so as to halt an enemy's advance. —*n.* 1. A prohibition by court order. 2. A Roman Catholic ecclesiastical censure whereby an offending person or district is excluded from participation in most sacraments and from Christian burial. [Learned respelling of Middle English *entrediten*, to announce ecclesiastical censure, from Old French *entredire* (past participle *entredit*), from Latin *interdicere*, to forbid: *inter*, preventively + *dicere*, to say (see *deik*- in Appendix*.)] —**in-ter-dic-tive**, **in-ter-dic-to-ry** *adj.* —**in-ter-dic-tive-ly** *adv.* —**in-ter-dic-tor** (-dik'tər) *n.*

in-ter-dic-tion (in'tər-dik'shən) *n.* 1. The act of interdicting. 2. The state of being interdicted. 3. An interdict.

in-ter-est (in'trīst, -tər-īst) *n.* 1. a. A feeling of curiosity, fascination, or absorption. b. The cause of any such feeling. c. The quality or aspect of something that enables it to cause any such feeling. 2. *Often plural*. Advantage; self-interest. 3. a. A right, claim, or legal share in something. b. *Usually plural*. Something in which such a right, claim, or share is held. c. Involvement with or participation in something. 4. a. *Abbr.* i. int. A charge for a financial loan, usually a percentage of the amount loaned. b. An excess or bonus beyond what is expected or due: *She returned his ardor with interest*. 5. *Usually plural*. A group of persons sharing an interest in an enterprise, industry, or segment of society. —*in the interest* (or *interests*) of. For the benefit of; in behalf of. —*tr.v.* interested, -esting, -ests. 1. To arouse the curiosity or hold the attention of. 2. To cause to become involved or concerned with. 3. *Obsolete*. To concern or affect. [Middle English, variant (influenced by Old French *interesse*, damage) of *interesse*, concern, share, from Norman French, substantive use of Latin *interesse*, "to be in between," to matter, be of concern: *inter*, between + *esse*, to be (see *es*- in Appendix*.)]

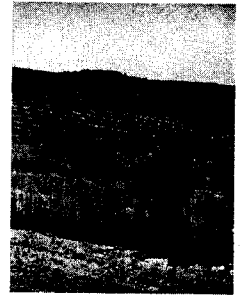
in-ter-est-ed (in'trī-stīd, -tər-ī-stīd, -tə-rēs'tīd) *adj.* 1. Having or showing curiosity, fascination, or concern. 2. Possessing a right, claim, or share. 3. Desirous of personal gain; self-seeking. —**in-ter-est-ed-ly** *adv.* —**in-ter-est-ed-ness** *n.*

in-ter-est-ing (in'trī-sīng, -tər-ī-sīng, -tə-rēs'tīng) *adj.* Arousing or holding attention; absorbing. —**in-ter-est-ing-ly** *adv.*

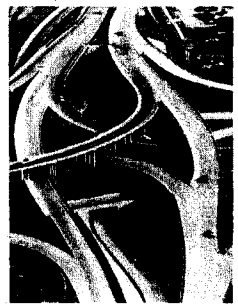
in-ter-face (in'tər-fās') *n.* A surface forming a common boundary between adjacent regions. —**in-ter-fa-cial** (-fā'shəl) *adj.*

in-ter-fer-e (in'tər-fīr') *intr.v.* -fered, -fering, -feres. 1. To be a hindrance or obstacle; impede. 2. *Football*. To impede illegally the catching of a pass. 3. To intervene or intrude in the affairs of others; meddle. 4. To strike one hoof against the opposite hoof or leg while moving. Used of a horse. 5. *Physics*. To produce interference with another wave. 6. *Electronics*. To inhibit or prevent clear reception of (broadcast signals). [Old French (*s'*) *entreferir*, to strike each other: *INTER-* + *ferir*, to strike, from Latin *ferire* (see *bher*-2 in Appendix*.)] —**in-ter-fer'er** *n.* —**in-ter-fer-ing-ly** *adv.*

Synonyms: *interfere, meddle, tamper*. These verbs are compared in the sense of concerning oneself in the affairs of other persons. *Interfere* and *meddle* are sometimes interchangeable.



intercrop
Apple orchard with intercropping of wheat



interchange
Four-level interchange, Fort Worth, Texas

light/th thin, path/th this, bathe/ü cut/ür urge/v valve/w with/y yes/z zebra, size/zh vision/ö about, item, edible, gallop, circus/
Fr. ami/æ Fr. feu, Ger. schön/ü Fr. tu, Ger. über/KH Ger. ich, Scot. loch/N Fr. bon. *Follows main vocabulary. †Of obscure origin.

poison. [Medieval Latin *intoxicāre*, to put poison in, poison : Latin *in-*, in + *toxicum*, poison (see *toxic*).] —*in-tox-i-ca'tion* *n.* —*in-tox-i-ca'tive* *adj.* —*in-tox-i-ca'tor* (-kă'tŏr) *n.*

intr. intransitive.

intra-. Indicates in, within, or inside of; for example, *intracostal*, *intramuscular*. **Note:** Many compounds other than those entered here may be formed with *intra-*. In forming compounds, *intra-* is normally joined with the following element without space or hyphen: *intraorbital*. However, if the second element begins with a capital letter or with the letter *a*, it is separated with a hyphen: *intra-European*, *intra-atomic*. [Late Latin, from Latin *intra*, on the inside, within. See *en* in Appendix*.]

in-tra-a-tom-ic (in'tră-ă-tŏm'ik) *adj.* Within an atom.

in-tra-car-di-ac (in'tră-kărd'ĕ-ăk) *adj.* Within a chamber of the heart.

in-tra-car-ti-lag-i-nous (in'tră-kărt'ă-lăj'ă-nəs) *adj.* Within cartilage.

in-tra-cel-lu-lar (in'tră-sĕl'yă-lăr) *adj.* Within a cell or cells.

in-tra-cos-tal (in'tră-kŏs'tal) *adj.* On the inner surface of a rib or ribs. [From *intra-* + *costa*.]

in-tra-cra-ni-al (in'tră-kră'nĕ-ol) *adj.* Within the skull.

in-trac-ta-ble (in-trăkt'ă-bal) *adj.* 1. Difficult to manage or govern; stubborn. 2. Difficult to mold or manipulate. 3. Difficult to alleviate, remedy, or cure. —See Synonyms at *unruly*. —*in-trac-ta-bil'i-ty*, *in-trac-ta-ble-ness* *n.* —*in-trac-ta-bly* *adv.*

in-tra-cu-ta-ne-ous (in'tră-kyŭtă-nĕ-əs) *adj.* Within the skin.

in-tra-dos (in-trădŏs', -dŏs') *n., pl. intrados* (-dŏz', -dŏz') or *-doses*. *Architecture*. The inner curve of an arch. [French, "inside back" : *intra-* + *dos*, back, from Old French, from Latin *dorsum* (see *dorsum* in Appendix*).]

in-tra-mo-lec-u-lar (in'tră-mŏlĕk'yă-lăr) *adj.* Within a molecule.

in-tra-mu-ral (in'tră-myŭr'ăl) *adj.* 1. Existing within bounds of an institution, especially a school. 2. *Anatomy*. Within the wall of a cavity or organ. —*in-tra-mu-ral-ly* *adv.*

in-tra-mus-cu-lar (in'tră-mŭs'kyă-lăr) *adj.* Within a muscle.

in-tran-si-gent (in-trăn'să-jĕnt) *adj.* Also *in-tran-si-geant*. Refusing to moderate an extreme position; uncompromising. [French *intransigent*, from Spanish *los intransigentes*, "the uncompromising" (name of a party of extreme republicans) : *in-*, not, from Latin + *transigere*, present participle of *transigir*, to compromise, from Latin *transigere*, to drive through, come to an understanding : *trans-*, through + *agere*, to drive (see *ag-* in Appendix*).] —*in-tran-si-gence*, *in-tran-si-gen'cy* *n.* —*in-tran-si-gent* *n.* —*in-tran-si-gent-ly* *adv.*

in-tran-si-tive (in-trăn'să-tiv) *adj.* *Abbr.* *intr.* i. Designating a verb or verb construction that does not require a direct object to complete its meaning. —*n.* An intransitive verb. [Late Latin *intransitivus* : *in-*, not + *transitivus*, TRANSITIVE.] —*in-tran-si-tive-ly* *adv.* —*in-tran-si-tive-ness* *n.*

in-tra-nu-cle-ar (in'tră-nŭ'klĕ-ăr, -nyŭ'klĕ-ăr) *adj.* Within a nucleus.

in-tra-state (in'tră-stăt') *adj.* Within the boundaries of a state.

in-tra-u-ter-ine (in'tră-yŭt'ăr-in, -tă-rin') *adj.* Within the uterus.

intrauterine device. *Abbr.* IUD A stainless steel or plastic loop, ring, or spiral inserted into the uterus as a contraceptive.

in-tra-va-sa-tion (in-trăvă-să'shən) *n.* The entry of foreign matter into a blood vessel. [*intra-* + *vas* + *-ation*.]

in-tra-vas-cu-lar (in'tră-văs'kyă-lăr) *adj.* Within the blood vessels or lymphatics.

in-tra-ve-na-tion (in'tră-vĕ-nă'shən) *n.* The entry of foreign matter into a vein.

in-tra-ve-nous (in'tră-vĕ-nəs) *adj.* *Abbr.* IV Within a vein or veins. —*in-tra-ve-nous-ly* *adv.*

in-treat. Variant of *entreat*.

in-trench. Variant of *entrench*.

in-trench-ment. Variant of *entrenchment*.

in-trep-id (in-trĕp'id) *adj.* Resolutely courageous; fearless; bold; "thinking is but the intrepid effort of the soul to keep the open independence of her sea" (Melville). See Synonyms at *brave*. [French, *intrepide*, from Latin *intrepidus* : *in-*, not + *trepidus*, agitated, alarmed (see *trep-* in Appendix*).] —*in-tre-pid'i-ty* (-tră-pid'ă-tĕ), *in-trep'id-ness* *n.* —*in-trep'id-ly* *adv.*

in-tri-ca-cy (in'trĭ-kă-sĕ) *n., pl. -cies*. 1. The condition or quality of being intricate. 2. Something intricate.

in-tri-cate (in'trĭ-kit) *adj.* 1. Having many complexly arranged elements. 2. Soluble or comprehensible only with painstaking effort. —See Synonyms at *complex*, *hard*. [Middle English *interkat*, from Latin *intricatus*, past participle of *intricare*, to entangle : *in-*, in + *tricae*, trifles, troubles, perplexities (see *extricate*).] —*in-tri-cate-ly* *adv.* —*in-tri-cate-ness* *n.*

in-tri-gant (in'tră-gănt) *n.* Also *in-tri-guant*. *Feminine in-tri-gante* (in'tră-gănt', -gănt'). An intriguer. [French, "intriguing," from Italian *intrigante*, present participle of *intrigare*, to INTRIGUE.]

in-trigue (in'trĕg', -in-trĕg') *n.* 1. A covert maneuver to achieve an unavowed purpose; a secret or underhand scheme. 2. The use of or involvement in such schemes. 3. A clandestine love affair. 4. Mystery; suspense. —See Synonyms at *conspiracy*. —*v.* (in-trĕg') *intrigued*, *-triguing*, *-trigues*. —*intr.* To engage in covert schemes; to plot. —*tr.* 1. To insinuate (one's way, for example) by scheming. 2. To arouse the interest or curiosity of. See Usage note. [French, from Italian *intrigo*, from *intrigare*, to perplex, from Latin *intricare*, to entangle. See *intricate*.] —*in-triguer* *n.*

Usage: *Intrigue*, as a transitive verb in the sense of arousing interest or curiosity, has been established on a popular level since the 1920's. It has been resisted by writers on usage, how-

ever, usually on the ground that it tends to displace words that would convey the desired sense more sharply. The following example is acceptable to 52 per cent of the Usage Panel: *The announcement of a special press conference intrigued the correspondents in the manner of a good suspense novel.*

in-trin-sic (in-trĭn'sik) *adj.* Also *archaic in-trin-si-cal* (-sĭ-kəl).

1. Pertaining to the essential nature of a thing; inherent: "the exploitive and oppressive relationships intrinsic to capitalism." (E.P. Thompson). 2. *Anatomy*. Situated within or belonging solely to a body part, as certain nerves and muscles. [Old French *intrinseque*, inner, from Late Latin *intrinsecus*, inward, from Latin, inwardly, on the inside : *intrin* (unattested), inward, from *intra*, within (see *en* in Appendix*) + *secus*, alongside (see *sek-w-* in Appendix*).] —*in-trin-si-cal-ly* *adv.*

intro-. Indicates: 1. In or into; for example, *introduction*. 2. Inward; for example, *introvert*. [Latin, from *intrō*, to the inside, inwardly. See *en* in Appendix*.]

intro. introduction; introductory.

in-tro-duce (in'tră-dŭs', -dyŭs') *tr.v.* -duced, -ducing, -duces. 1. To identify and present; especially, to make (a stranger or strangers) acquainted. 2. To present and recommend (a plan, for example) for consideration. 3. To bring into currency, use, or practice; originate. 4. To bring in and establish: *introduce exotic birds*. 5. To insert or inject. 6. To inform of something for the first time. 7. To preface; to open. [Latin *intrōducere*, to lead in : *intrō-*, in + *ducere*, to lead (see *deuk-* in Appendix*).] —*in'tro-duc'er* *n.* —*in'tro-duc'i-ble* *adj.*

in-tro-duc-tion (in'tră-dŭk'shən) *n.* *Abbr.* *intro.* 1. The act of introducing. 2. The fact of being introduced. 3. A means of presenting one person to another, as a personal presentation or formal letter. 4. Something recently introduced: "He loathed a fork; it is a modern introduction which has still scarcely reached common people." (D.H. Lawrence). 5. Anything spoken, written, or otherwise presented in introducing, especially: a. A preface, as in a book. b. A short preliminary movement in a musical work. 6. A basic instructive text or course of study. [Middle English *introduccion*, from Old French *introduction*, from Latin *introduc-tiō*, from *intrōducere*, INTRODUCE.]

in-tro-duc-to-ry (in'tră-dŭk'tă-rĕ) *adj.* Also *in-tro-duc-tive* (-tĭv). *Abbr.* *intro.* Serving to introduce. —*in'tro-duc'to-ri-ly* *adv.*

in-tro-it (in-trŏ'it) *n.* Also *Introit*. *Ecclesiastical*. 1. A hymn or psalm sung at the opening of a service, especially in the Anglican Church. 2. The beginning of the proper of the Mass in the Roman Catholic Church, usually consisting of a psalm verse, antiphon, and the Gloria Patri. [Middle English, "entrance," beginning, from Old French *introit*, from Latin *introitus*, from the past participle of *introyre*, to go in, enter : *intrō-*, into + *ire*, to go (see *ei-* in Appendix*).]

in-tro-jec-tion (in'tră-jĕk'shən) *n.* 1. The ascribing of living characteristics to inanimate objects. 2. The unconscious incorporation into one's personality of the characteristics of another person or of an inanimate object. [INTRO- + (PRO)JECTION.]

in-tro-mis-sion (in'tră-mĭsh'ən) *n.* Introduction; admission. [Medieval Latin *intrōmissiō*, from Latin *intrōmittere*, INTROMIT.] —*in-tro-mis'sive* *adj.*

in-tro-mit (in'tră-mĭt') *tr.v.* -mitted, -mitting, -mits. To cause or permit to enter; introduce or admit. [Middle English *intromitten*, from Latin *intrōmittere*, to send or put in, introduce : *intrō-*, in + *mittere*, to send (see *smeit-* in Appendix*).] —*in'tro-mit'tent* *adj.* —*in'tro-mit'ter* *n.*

in-trorse (in-trŏrs') *adj.* *Botany*. Facing inward; turned toward the axis. Said especially of anthers. [Latin *introrsus*, contracted from *intrōversus*, turned inward : *intrō-*, inward + *versus*, past participle of *vertere*, to turn (see *wer-* in Appendix*).]

in-tro-spect (in'tră-spĕkt') *intr.v.* -spected, -specting, -spect. To turn one's thoughts inward; examine one's own feelings. [Latin *intrōspicere* (past participle *intrōspectus*), to look into : *intrō-*, into + *specere*, to look (see *spek-* in Appendix*).]

in-tro-spec-tion (in'tră-spĕk'shən) *n.* Contemplation of one's own thoughts and sensations; self-examination.

in-tro-spec-tive (in'tră-spĕk'tĭv) *adj.* 1. Of or pertaining to introspection. 2. Given to private thought; contemplative.

—*in'tro-spec'tive-ly* *adv.* —*in'tro-spec'tive-ness* *n.*

in-tro-ver-sion (in'tră-vŭr'zhən, -shən) *n.* 1. The act of introverting or the condition of being introverted. 2. The directing of one's thoughts and interests inward. Compare *extroversion*. 3. *Medicine*. The turning of one part within another. —*in'tro-ver'sive* *adj.*

in-tro-vert (in'tră-vŭrt') *v.* -verted, -verting, -verts. —*tr.* 1. To turn or direct inward. 2. To concentrate (one's interests) upon oneself. 3. To turn (a tubular organ or part) inward upon itself. —*intr.* To exhibit introversion. —*n.* (in'tră-vŭrt'). 1. A person whose thoughts and interests are directed inward. Compare *extrovert*. 2. An anatomic structure, such as the intestine, that is turned inward upon itself. [New Latin *introvertere* : INTRO- + Latin *vertere*, to turn (see *wer-* in Appendix*).]

in-trude (in-trŭd') *v.* -truded, -truding, -trudes. —*tr.* 1. To interpose (oneself or something) without invitation, fitness, or leave. 2. *Geology*. To thrust (molten rock) into a stratum. —*intr.* To come in rudely or inappropriately; enter as an improper or unwanted element: "The flute would be intruding here like a delicate lady at a club smoker." (Leonard Bernstein). [Latin *intrudere*, to thrust in : *in-*, in + *trudere*, to thrust (see *trud-* in Appendix*).] —*in-trud'er* *n.*

Synonyms: *intrude*, *obtrude*, *interlope*. These verbs mean to force oneself or something upon other persons without their consent or approval. *Intrude* is more often found in the sense of violating another's privacy, and *obtrude* in the transitive sense